Catalogue no. 21-021-MIE — No. 002
ISSN: 1708-1939
ISBN: 0-662-37067-8

Research Paper

Manure Management in Canada

2004, Vol. 1, No. 2

by Martin S. Beaulieu

Agricultural Division
Jean Talon Building, 12th floor, Ottawa, K1A 0T6

Telephone: 1 800-465-1991

This paper represents the views of the author and does not necessarily reflect the opinions of Statistics Canada.

Statistics Canada Statistique Canada

Canada

How to obtain more information

Specific inquiries about this product and related statistics should be directed to Client Services, agricultural Division, Statistics Canada at 1 800 465 – 1991 or by email: agriculture@statcan.ca.

For information on the wide range of data available from Statistics Canada, you can contact us by calling one of our toll-free numbers. You can also contact us by e-mail by visiting our Web site.

National inquiries line	**1 800 263-1136**
National telecommunications device for the hearing impaired	**1 800 363-7629**
E-mail inquiries	**infostat@statcan.ca**
Web site	**www.statcan.ca**

Ordering and subscription information

Farm Environmental Management in Canada, Catalogue no. 21-021-MIE, is available on the internet free of charge. Users can obtain copies at http://www.statcan.ca/english/freepub/21-021-MIE/free.htm.

A free catalogue of products and services is available upon request.

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner and in the official language of their choice. To this end, the Agency has developed standards of service which its employees observe in serving its clients. To obtain a copy of these service standards, please contact Statistics Canada toll free at 1 800 263-1136.

The publication *Farm Environmental Management in Canada* includes a series of articles aimed at publishing comprehensive results of the *2001 Farm Environmental Management Survey*. It was prepared under the direction of:

Editor:Robert Koroluk
Survey Manager: Zoltan Somogyi
Author: Martin S. Beaulieu
Special thanks: Neil Rothwell

Funding and assistance in the preparation of this publication were provided primarily by Agriculture and Agri-Food Canada under the National Agri-environmental Health Analysis and Reporting Program (NAHARP). This program is part of the environmental component of the Agriculture Policy Framework (APF).

Statistics Canada

Agriculture Division

Manure Management in Canada

2004, Vol. 1, No. 2

Published by authority of the Minister responsible for Statistics Canada.

© Minister of Industry, 2004

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without prior written permission from Licence Services, Marketing Division, Statistics Canada, Ottawa, Ontario, Canada K1A 0T6.

June 2004

Catalogue no. 21-021-MIE

ISSN: 1708-1939
ISBN: 0-662-37067-8

Frequency: Irregular

Ottawa

La version française de cette publication est disponible sur demande (n° 21-021-MIF au catalogue).

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

106-00122/

Symbol Legend

The following standard symbols are used in Statistics Canada publications:

.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
p	preliminary
r	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
E	use with caution
F	too unreliable to be published

Table of Contents

	Page
Highlights	8
Introduction	9
Manure Management Practices	10
Seasonal application of manure	10
Manure incorporation into soil	17
Treatment of stored manure	22
Feeding strategies to reduce manure nutrient content	23
Control of odours from livestock buildings	26
Development of formal manure management plans	29
Adoption of beneficial management practices for manure management	32
Summary	35
Appendix A: Manure Production Coefficients	37
Appendix B: Statistical Tables	39

ELECTRONIC PUBLICATIONS AVAILABLE AT
www.statcan.ca

Manure Management in Canada

Manure Management in Canada presents information on various characteristics of manure management as practised on Canadian farms. This analysis is based on results of the 2001 Farm Environmental Management Survey (FEMS) and discussion focuses mainly on farms raising some level of livestock, irrespective of the major commodities produced.

Canadian farmers are actively involved in environmental initiatives and are adopting farming practices that minimize pollution risks to air, water and soil, while contributing to the conservation of biodiversity. FEMS results provide useful information for measuring the adoption of environmentally sound practices and for assisting governments, farmers and non-governmental organizations in the promotion and development of new farm environmental programs and practices. FEMS results show that there are differences between provinces with respect to manure management practices.

Note to readers:

Readers should be aware that FEMS data alone, though providing a wealth of information, are insufficient to assess environmental risks. The FEMS data are meant to provide an overall picture of various farming practices that may have an impact on the environment. To have a full appreciation of farmers' adoption of environmental management practices and of their impacts (positive or negative) on the environment, additional information and more comprehensive analysis is required. Thus, readers are advised to use caution when interpreting these data.

A previous survey, the 1995 Farm Input Management Survey (FIMS), collected similar information on manure management in Canada. However, FIMS and FEMS data cannot be readily compared because of differences in survey design, sample size and questions asked.

Highlights

The 2001 FEMS data show that nationally:

- Most manure was applied to the land during the fall and spring months respectively, while only a very small proportion of manure was applied during the winter months;
- Beef, dairy and hog production all showed seasonal differences in quantities of manure applied, though there was little difference in the seasonal application of manure between farms with smaller or larger herds;
- Almost half (47.1%) of the manure produced in 2001 was left on the field surface or incorporated into the soil more than a week after it was spread on the field while 17.7% of manure was injected into the soil or incorporated the same day it was applied to the land;
- More than half (53.3%) of beef cattle manure was left on the surface or incorporated into the soil after more than a week while 38.5% of hog manure was injected or incorporated into the soil the same day it was spread on the field; farms with larger herds had the largest proportions of manure injected or incorporated into the soil without delay;
- Most farms did not use feed additives or feeding strategies to reduce nutrient content of manure, though almost half (40.4%) of the largest hog farms used feed additives or rations to reduce manure nutrient content;
- About one-quarter of the farms used some method to control odours associated with livestock buildings. The highest share of livestock buildings with odour control methods were found on hog farms;
- About one-quarter of manure produced was on farms that had formal manure management plans required by government regulations, nutrient management plans or plans developed because of concerns for the environment;
- 32.6% of manure was on farms that had fully implemented beneficial management practices (BMPs) related to manure management while 15.9% of manure was on farms having partially implemented BMPs;
- 41.7% of manure was produced on farms where the respondents reported that they were unfamiliar with BMPs for manure in their region.

1. Introduction

Manure Management in Canada is the second article in a series of studies collectively called *Farm Environmental Management in Canada*. The objective of this series is to publish the results of the 2001 Farm Environmental Management Survey (FEMS).[1] The series presents information about the farming practices used on Canadian farms as they relate to a number of agri-environmental topics such as manure handling, water management, chemical inputs and sustainable land management practices.

Agricultural activities by their very nature have a significant impact on the environment. Tillage practices alter natural landscapes, agricultural inputs enter ecosystems and animal by-products influence ecological balances. Because of environmental concerns, Canadian farmers are at the frontlines as stewards of the environment. Farmers are actively involved in environmental programs and are adopting farming practices that minimize pollution risks to air, water and soil, while contributing to the conservation of biodiversity. FEMS results provide useful information for measuring the adoption of environmentally-sound practices and assisting governments, farmers and non-governmental organizations in the promotion and development of farm environmental initiatives.

Manure Management in Canada provides information on the key livestock manure management practices that Canadian farmers followed in 2001. To assess the importance of these practices, results are often best presented on the basis of the amount of manure produced on farms rather than by the number of farms. The number of farms alone does not always give a full appreciation of the significance of the adoption of specific practices, in terms of potential affects on the environment. Practices on many small farms may not have the same environmental impact as the same practices on a few very large farms because of relatively lower production intensities. Conversely, the number of farms provides valuable information on the extent to which the farm community is aware of and has adopted farming practices that are more environmentally sound. The following analysis focuses more specifically on manure management practices used for the production of beef cattle, dairy cattle and hogs, which together generate the largest amount of manure on Canadian farms.[2] Although the focus of this analysis is mainly at the national level, some highlights about manure management are also presented on a provincial basis.

The topics covered comprise most of the key characteristics of manure management.[3] Topics include seasonal application of manure to the land, delay in incorporating manure into soil, treatment of stored manure, use of feeding strategies to reduce manure nutrient content, options used to control odours, implementation of manure management plans and adoption of beneficial management practices.

[1] FEMS was conducted in March 2002 by Statistics Canada for Agriculture and Agri-Food Canada. The survey provides a broad coverage of farm management practices that are related to the environment in all sectors of Canadian agriculture.

[2] This article does not examine manure management practices on poultry and other livestock production due to data limitations.

[3] The first article in this series, *Manure Storage in Canada*, addresses issues related specifically to manure storage systems. Readers can find this article on Statistics Canada's web site at http://www.statcan.ca/english/freepub/21-021-MIE/free.htm .

2. Manure management practices

2.1 Seasonal application of manure

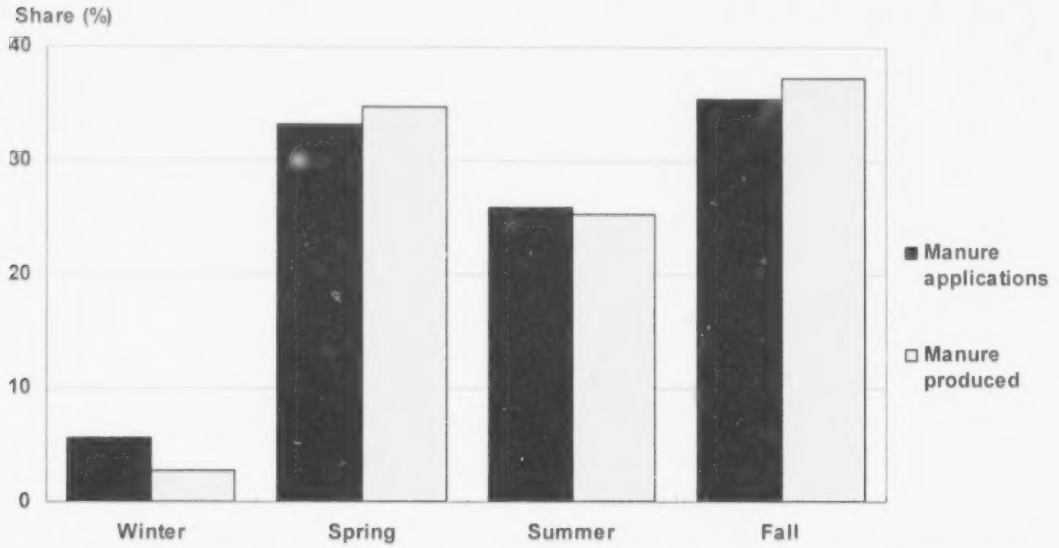
Though practices vary, livestock manure is ultimately disposed of by applying it to farmland. Manure application occurs at different times during the year, though usually from spring to fall. The timing of application depends on various factors such as weather conditions, stage of crop growth, labour availability and manure storage capacity. Manure storage capacity is an important factor, as storage facilities tend to be full after the winter months and require emptying. Furthermore, livestock producers need to ensure sufficient storage capacity is present in the fall for the coming winter months. Farmers raising livestock under confined conditions, in operations such as beef feedlots and dairy, hog and poultry barns, usually store manure until it can be conveniently applied to land. This is preferably done at a time when crops can benefit most from the nutrients in manure and when environmental risks from application are at a minimum. According to beneficial management practices, manure should be applied to land outside of the frost season.

Nationally, FEMS results show that farms applied manure mostly in the fall (35.4% of applications), followed closely by applications in the spring (33.2%), as shown in Figure 1. About one-quarter (25.9%) of manure applications were performed in the summer months. In comparison, 5.5% of manure applications, by far the lowest proportion, were in winter, generally considered an unfavourable time because of the potential for run-off due to frozen ground. It should be noted that the figures quoted above were generated by using the sum of all the responses given for each season as the denominator.

During the survey, Canadian farmers reported the percentage of the manure produced on their farms in 2001 that was applied in each season. Annual manure production, as-excreted, was estimated for each farm on the basis of livestock inventories on farms as reported on the 2001 Census of Agriculture.[4] FEMS results show that nationally 37.3% of manure was applied in fall, 34.7% was applied in the spring and 25.3% in the summer. A smaller proportion (2.7%) of manure was applied during the winter months.

[4] FEMS results have been combined with estimated manure production coefficients and 2001 Census of Agriculture livestock numbers to estimate annual manure production, helping to illustrate the significance of the many survey results. (For details on the methodology used to calculate manure production, see Appendix 1.) Throughout the article, we will refer to these extended calculations as FEMS results.

Figure 1: Seasonal application of manure, Canada, 2001



Note: The numbers in a particular season are shown as a proportion of the sum of all responses reported for the whole year in that category.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Application by manure source

Seasonal differences in the proportion of manure applied to land are also related to the different types of animals being produced on farms. These differences are mostly due to the farming practices associated with beef, dairy and hog production.

Nationally, beef farms applied manure mostly in the fall (38.4% of applications) and in the spring (31.4%) (Table 1). Similarly, hog farms applied manure mostly in these two seasons but in different proportions, with 32.2% of manure applications performed in the fall and 36.0% in the spring. However, 8.6% of manure applications performed by hog farms were in the winter, compared to 5.3% and 5.1% for dairy and beef farms, respectively. Dairy farms performed 35.8% of their manure applications in the spring, followed by 30.0% in the summer and 28.9% in the fall.

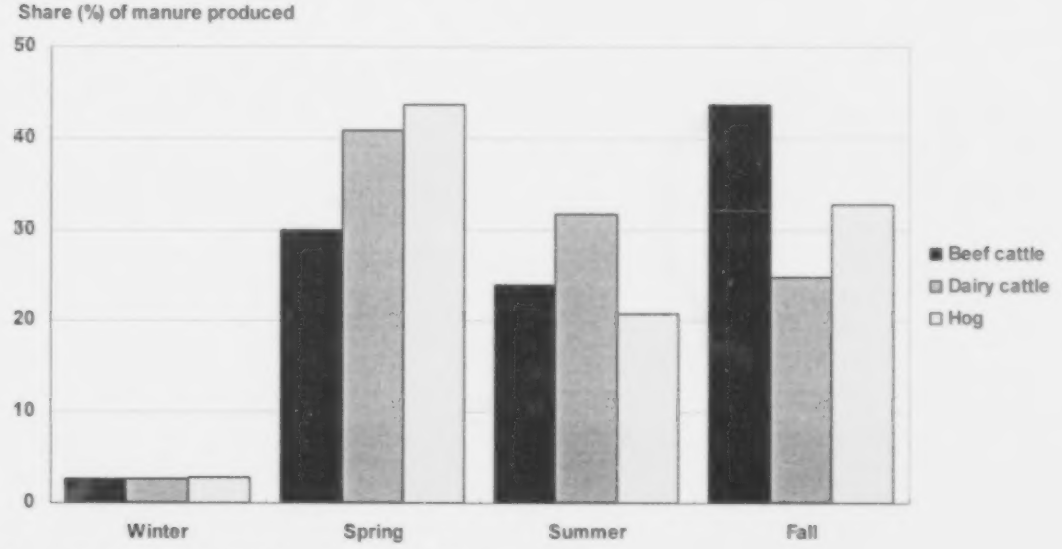
Table 1. Seasonal application of manure, by animal type, Canada, 2001

	Winter	Spring	Summer	Fall
	Share of manure applications (%)			
Beef cattle	5.1	31.4	25.1	38.4
Dairy cattle	5.3	35.8	30.0	28.9
Hog	8.6	36.0	23.2	32.2

Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. The numbers in a particular season are shown as a proportion of the sum of all responses reported for the whole year in that category. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Beef cattle are produced using a variety of production systems ranging from small, pasture-based cow-calf operations to large intensive feedlots raising cattle in enclosed pens or corrals. Nationally, 43.6% of beef cattle manure was applied to the land in the fall and 29.9% in the spring (Figure 2). These differences could be explained by a number of factors. First, early spring is a busy period on some cattle operations because of calving and spring seeding operations and farmers may not have time for applying manure. Second, beef producers usually need to empty their storage facilities before winter and must do this in fall if they haven't had the opportunity to do it before then. More time is usually available after harvest for this task and the farmer does not need to worry about interfering with the progress of growing crops.

Figure 2: Proportion of manure applied, by season of application and animal type, Canada, 2001



Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Dairy cattle, especially on small- and medium-size enterprises, are usually raised indoors during the winter months and mostly outdoors during the rest of the year. About 40% of dairy cattle manure production was applied to the land in the spring and about one-quarter (24.8%) was applied in the fall. However, this seasonal pattern may change as dairy operations increase in size and more animals are confined indoors all year round.

Hog farms make use of liquid manure storage systems to the greatest extent amongst livestock producers and usually empty their manure storage tanks prior to and after winter. As with dairy producers, farmers raising hogs applied the largest amount of manure (43.6%) to land during the spring. But like beef producers, hog farmers applied relatively less manure to land during the summer (20.8%), with almost one-third (32.7%) of manure produced being applied in fall. Application of liquid manure in the warmer summer months without injection into the soil could result in a significant amount of nutrient evaporation into the air, with the potential of odours affecting neighbouring areas.

Regional characteristics of manure application

Regional differences in the seasonal application of manure to the land are mostly due to variations in local climatic conditions, agronomic environment, types of animals raised, manure storage systems used and environmental regulations. However, winter application is not generally recommended in any region because frozen land cannot absorb nutrients contained in manure. It is important to note that individual farms often apply manure in more than one season. Consequently, a farm can be counted more than once and the share of farms with livestock will sum to more than 100%. In contrast, the quantity of manure applied represents a discrete count. Therefore, the share of manure applied will sum to 100%.

Table 2 shows that one-quarter of livestock farms in British Columbia applied some manure in winter in 2001, however the actual quantity of manure was low (5.2%). In Ontario, 15.8% percent of livestock farms applied manure in winter. In the southern parts of British Columbia and Ontario, relatively mild winters make it possible to apply some manure in early winter. No farmers reported applying manure during the winter in Newfoundland and Labrador and only 0.2% of farms in Quebec reported winter application. Significant numbers of farms in the Prairie provinces reported applying some manure in winter, but in all cases the quantities applied were small.

In Canada as a whole, the share of farms applying manure in the spring and fall were similar. However, there was a marked regional pattern. In the spring, the share of farms applying manure in Eastern and Central Canada and British Columbia varied between 63.5% and 95.8% while in the Prairie provinces the comparable numbers ranged between 26.8% and 41.9%. In the fall, the share of farms applying manure was fairly constant across all provinces (at around 60%).

In the spring, the share of manure applied in the non-Prairie provinces averaged about one-half of that applied throughout the year, while the share in the Prairie provinces was approximately one-quarter.

In the fall, the non-Prairie provinces applied around one-third of their annual manure application. In contrast, the comparable share of manure applied in the Prairie provinces varied between 44.9% and 54.5%.

In the Prairie provinces, a larger proportion of manure application takes place in the fall because spring is often too busy a time to apply manure while crop growth reduces opportunities to apply manure in the summer. Moreover, manure storage facilities need to be emptied before the prairie winter.

In Canada as a whole, 42.2% of farms applied manure in the summer. The Prairie provinces were somewhat below this average, varying between one-quarter and one-third, while Quebec was considerably higher (72.9%).

With two exceptions, the share of manure applied in the summer was broadly consistent across all the provinces (approximately one-quarter). The two exceptions were Newfoundland and Labrador (only 11.6% of annual manure applied) and British Columbia (15.7% of annual manure applied).

Quebec stood out amongst the provinces with a relatively large share of farms applying manure in the spring (72.3%) and summer (72.9%), and a relatively small share of farms applying manure in the fall (43.0%). Quebec's high spring and summer application can be explained by the relative importance of the dairy sector in the province, which needs to empty storage facilities in the spring and applies manure to forage crops in the summer.

Table 2: Seasonal application of manure, Canada and provinces, 2001

	Winter	Spring	Summer	Fall
		Share of farms with livestock (%)		
Newfoundland and Labrador	0.0	95.8	25.0	66.7
Prince Edward Island	X	72.0	X	55.9
Nova Scotia	X	77.3	X	61.7
New Brunswick	3.6	63.5	41.0	63.5
Quebec	0.2	72.3	72.9	43.0
Ontario	15.8	68.3	43.4	63.7
Manitoba	11.4	32.2	36.5	66.5
Saskatchewan	5.8	26.8	30.7	60.7
Alberta	8.9	41.9	26.8	58.4
British Columbia	24.8	79.7	41.0	43.5
Canada	**9.2**	**53.3**	**42.2**	**57.6**
		Share of manure produced on these farms (%)		
Newfoundland and Labrador	0.0	56.8 E	11.6	31.6
Prince Edward Island	X	49.0	X	36.7
Nova Scotia	1.7	41.9	27.7	29.3
New Brunswick	0.9	40.3	24.8	34.0
Quebec	X	43.9	X	15.6
Ontario	4.6	40.5	23.3	31.6
Manitoba	2.9	20.8	21.8	54.5
Saskatchewan	1.8	28.4	24.3	45.5
Alberta	3.2	30.8	21.1	44.9
British Columbia	5.2	47.9	15.7	31.1
Canada	**2.7**	**34.7**	**25.3**	**37.3**

E Use with caution.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. The share of farms with livestock do not sum to 100% because it was possible for an individual farm to apply manure in more than one season.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Manure application by farm size

The influence of farm size[5] is important to consider when looking at manure management practices. Large livestock operations tend to have higher concentrations of animals on a given land area, putting relatively greater stress on the environment. As a result, larger livestock farms generally face greater public scrutiny and stricter environmental regulations.

On beef farms (Table 3), winter application of manure is very small (7.9% of farms applying 2.6% of the annual manure application). There was no discernable pattern based on farm size.

[5] For more detail on how size categories were established, consult the first article on Manure Storage: http://www.statcan.ca/english/freepub/21-021-MIE/2003001/method.htm#1.

In spring, nearly one-half of beef farms applied manure to the land and the share of manure applied was 29.9%. There was a consistent rise in the share of manure applied according to farm size. The share rose from 27.3% for farms with less than 163 head of beef cattle to 34.8% with farms with more than 425 head.

In the summer, a little more than one-third of beef farms applied manure to the land. The share of manure applied during this season was 24.0%. There was no obvious pattern based on farm size.

In the fall, more beef farms (57.7%) applied manure to the land than in any other season. The share of manure applied was also the highest (43.6%). There was a general pattern of a declining share of manure applied with increasing farm size (from 45.7% of the smallest beef farms to 38.2% of the largest farms).

Amongst dairy farms, one-tenth applied manure to the land in winter. However, this volume represented only 2.6% of the manure applied throughout the year by all dairy farms. There was no pattern based on farm size.

In contrast to beef farms, spring represented the highest share of dairy farms applying manure to the land (approximately three-quarters) and the highest share of manure applied (40.8%). Moreover, there was a general pattern of a rising share of manure applied with increasing farm size (from 34.9% by farms with less than 47 head to 42.9% by farms with more than 131 head).

In summer, nearly two-thirds of dairy farms applied manure to the land, producing 31.7% of the manure applied throughout the year. Unlike the spring, there was a consistent decline in the share of manure applied to the land with increasing farm size (from 36.2% by farms with less than 47 head down to 28.6% by farms with more than 131 head).

In fall, 60.8% of dairy farms applied manure to the land. These farms applied a little under one-quarter of the total manure applied throughout the year by dairy farms. For farms with less than 132 head there was a consistent decline in the share of manure applied to the land with increasing farm size (from 26.1% to 23.0%). However, the share of manure applied in the fall by the largest dairy farms was the highest for this season (26.2%).

In winter, hog farms had both a larger share of farms applying manure to the land (17.8%), and a larger share of manure applied to the land (2.9%) than either beef farms or dairy farms. The share of manure applied in winter by hog farms also consistently declined with increasing farm size (from 5.1% by farms with less than 566 head to 2.3% by farms with more than 1,594 head). This pattern suggests a lower manure storage capacity on farms with smaller herds. It is more difficult for operators of smaller farms, which often operate under tight margins, to make the capital investments required to increase their manure storage capacity. Consequently, some are forced to empty manure storage systems and to apply it to the land during the frost season.

In spring, almost three-quarters of hog farms applied manure to the land. The share of manure applied in this season was 43.6%. There was no obvious pattern based on farm size.

In summer, a little under one-half of hog farms applied manure to the land and the manure produced accounted for 20.8% of the total manure applied throughout the year. The share of manure applied to the land consistently declined with increasing farm size (from 24.9% by the smallest farms to 19.3% by the largest farms).

A majority (65.9%) of hog farms applied manure to the land in the fall. This was a higher proportion than that seen on both beef farms and dairy farms in this season. The share of manure applied during the fall by hog farms was just under one-third. There was no obvious pattern based on farm size.

Table 3: Seasonal application of manure, by size of herd, Canada, 2001

Herd size	Winter	Spring	Summer	Fall
	Share of farms with livestock (%)			
Beef cattle				
1-162 head	7.5	46.5	37.9	57.3
163-281 head	11.1	46.3	33.5	63.0
282-425 head	6.1	47.2	35.0	58.6
426 or more head	16.0	56.1	44.5	55.5
All farm sizes	**7.9**	**46.8**	**37.7**	**57.7**
Dairy cows and heifers				
1-46 head	10.2	61.7	54.3	54.0
47-81 head	8.7	77.1	68.2	61.5
82-131 head	14.7	89.8	69.1	66.5
132 or more head	14.9	89.1	71.6	71.1
All farm sizes	**10.9**	**75.3**	**63.9**	**60.8**
Hogs				
1-565 head	18.5	62.8	42.1	62.7
566-981 head	22.6	93.0	60.5	71.2
982-1,594 head	15.9	87.0	53.9	65.9
1,595 or more head	13.8	90.2	53.5	72.3
All farm sizes	**17.8**	**74.8**	**48.0**	**65.9**
	Share of manure produced on these farms (%)			
Beef cattle				
1-162 head	2.0	27.3	25.0	45.7
163-281 head	3.9	28.9	20.9	46.3
282-425 head	1.1	33.8	24.8	40.4
426 or more head	3.3	34.8	23.7	38.2
All farm sizes	**2.6**	**29.9**	**24.0**	**43.6**
Dairy cows and heifers				
1-46 head	2.9	34.9	36.2	26.1
47-81 head	1.9	39.5	33.9	24.7
82-131 head	3.7	43.4	29.9	23.0
132 or more head	2.3	42.9	28.6	26.2
All farm sizes	**2.6**	**40.8**	**31.7**	**24.8**
Hogs				
1-565 head	5.1	37.5	24.9	32.5
566-981 head	4.2	46.0	24.4	25.5
982-1,594 head	3.2	46.9	22.4	27.4
1,595 or more head	2.3	43.2	19.3	35.2
All farm sizes	**2.9**	**43.6**	**20.8**	**32.7**

Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

2. The share of farms with livestock do not sum to 100% because it was possible for an individual farm to apply manure in more than one season.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

2.2 Manure incorporation into soil

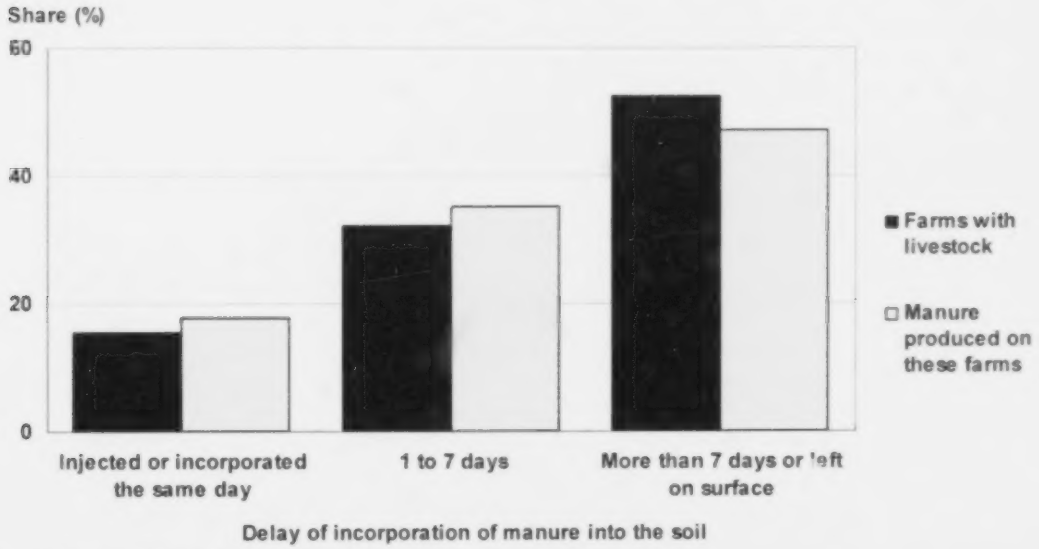
Manure incorporation delay

Different methods can be used to apply manure to land, including solid spreaders, liquid spreaders, liquid injectors and irrigation systems. If manure is spread on the surface of the soil, BMPs usually recommend that manure be then incorporated into the soil in order to minimize environmental risks and improve nutrient utilization. Injection of liquid manure and incorporation of solid manure without much delay are practices that reduce the amount of ammonia lost into the air. By incorporating manure rapidly into the soil, farmers minimize odours and nutrient loss due to evaporation. Delay in incorporating manure into soil depends on the type of manure (solid, semi-solid or liquid) and the application method.

Injection has the advantage of leaving more crop residue on the soil surface. Greater residue reduces both the risk of soil erosion and the loss of nutrients due to water run-off or evaporation. However, the incorporation of solid manure is more resource intensive (in terms of labour and fuel) than spreading applications that leave manure on the surface of the field.

In FEMS, livestock producers reported their normal delay in incorporating manure into their soil (Figure 3). Results indicate that 52.4% of farms that produce livestock in Canada either left manure on the soil surface or incorporated it more than a week after its application to the land; these farms account for 47.1% of the manure applied in 2001. About 15% of livestock farmers injected or incorporated manure on the same day that it was applied to land, corresponding to 17.7% of the manure applied. Almost one-third of livestock producing farms incorporated manure into soil in the one to seven days following application. This corresponds to 35.2% of the manure applied to the land.

Figure 3: Timing of manure incorporation into the soil, Canada, 2001



Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Manure incorporation delay by animal type

Differences in the length of delay of manure incorporation into the soil were evident when farms were separated by the type of livestock produced. Nationally, the majority of beef producers (55.1%) left manure on the soil surface or incorporated it into the soil more than a week after its application (Table 4 and Figure 4); these farms produced 53.3% of beef cattle manure. In comparison, 46.1% of dairy farms and 43.9% of hog farms left manure on the surface for more than a week. These farms produced 37.6% and 27.7% of dairy cattle and hog manure, respectively. Conversely, 13.4% of beef farms, 17.5% of dairy farms and 21.9% of hog farms injected manure into the soil or incorporated it on the same day, accounting for 13.1%, 25.2% and 38.5% of beef cattle, dairy cattle and hog manure, respectively.

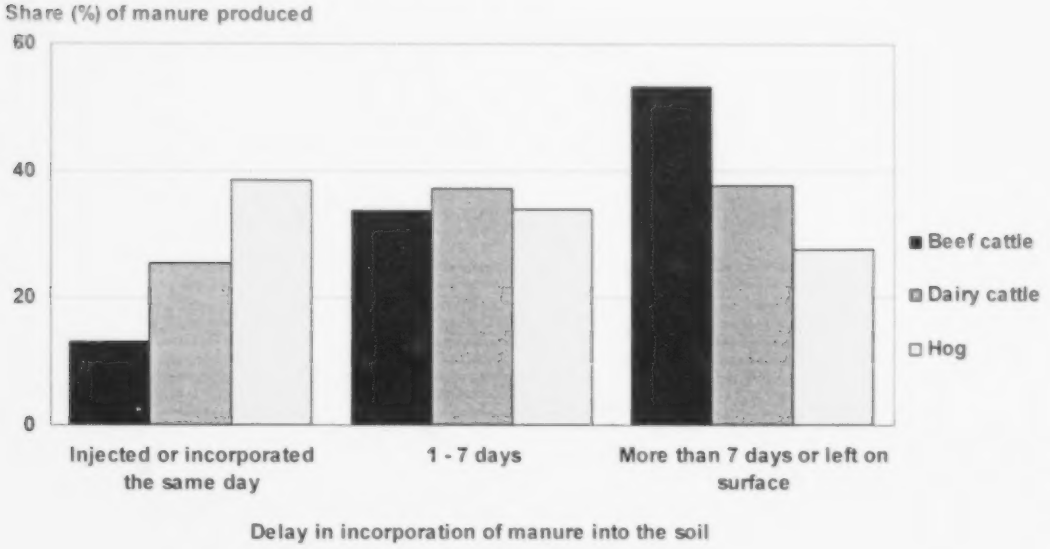
Roughly one-third of beef, dairy and hog farms did not incorporate manure into the soil immediately, but did so within a week of application. The higher proportion of hog manure injected or incorporated into the soil could be explained by the fact that most hog manure is stored in a liquid form, which can be injected relatively easily.

Table 4. Timing of manure incorporation into the soil, by animal type, Canada, 2001

	Manure injected or incorporated the same day		Manure incorporated within 1 to 7 days		Manure incorporated after more than 7 days or left on surface	
	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)
Beef cattle	13.4	13.1	31.5	33.6	55.1	53.3
Dairy cattle	17.5	25.2	36.5	37.2	46.1	37.6
Hog	21.9	38.5	34.3	33.8	43.9	27.7

Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Figure 4: Timing of manure incorporation into the soil, by animal type, Canada, 2001



Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Regional perspectives of manure incorporation

Differences in the length of delay of manure incorporation into the soil occur from one province to another (Table 5). These differences are mostly due to differences in the type of animals raised, which influences the type of manure storage system used (liquid or semi-solid/solid) in each province.

The provinces with the highest shares of injected manure or manure incorporated the same day of its application were Manitoba (20.8% of manure, 18.1% of farms), Ontario (19.7% of manure, 17.0% of farms) and Quebec (18.2% of manure, 16.5% of farms). This could be explained by the importance of the hog industry in these provinces, which together account for 73.5% of all pigs in Canada.[6] These results give the first indication that larger farms tend to inject or incorporate manure with less delay than smaller farms since the quantities are higher than the number of farms in each of these provinces. This observation is confirmed in the next section.

Saskatchewan, British Columbia, and Prince Edward Island each had more than half of their manure production left on the surface of the soil or incorporated into the soil more than a week after its application. A possible explanation is that these provinces reported a low proportion of farms with liquid manure storage, which is frequently injected. In addition, a high proportion of beef cattle farms typically store solid manure, which usually remains unincorporated for longer periods.

[6] Statistics Canada, 2001 Census of Agriculture.

Table 5: Timing of manure incorporation into the soil, Canada and provinces, 2001

	Manure injected or incorporated the same day		Manure incorporated within 1 to 7 days		Manure incorporated after more than 7 days or left on surface	
	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)
Newfoundland and Labrador	X	X	X	F	71.7	F
Prince Edward Island	X	13.8	X	32.8	60.9	53.5
Nova Scotia	9.8	X	20.2	X	69.9	X
New Brunswick	14.7	15.6	31.8	40.7	53.5	43.7
Quebec	16.5	18.2	35.7	36.7	47.8	45.1
Ontario	17.0	19.7	38.5	42.8	44.6	37.4
Manitoba	18.1	20.8	31.5	33.5	50.4	45.7
Saskatchewan	9.4	13.9	25.1	29.8	65.5	56.3
Alberta	15.9	17.9	27.8	34.0	56.3	48.0
British Columbia	11.3	15.6	20.0	29.0	68.7	55.4
Canada	**15.3**	**17.7**	**32.2**	**35.2**	**52.4**	**47.1**

F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Manure incorporation delay by farm size

Table 6 shows that there are differences in the length of delay of incorporating manure into the soil related to herd size. As the size of beef cattle farms increased, manure was more rapidly incorporated, thus leaving less manure on the surface for more than a week. For example, 51.5% of large beef cattle farms (426 or more head), producing 53.8% of beef cattle manure, either injected or incorporated manure within a week of application. In comparison, 44.6% of small beef farms (less than 163 head), which produced 42.5% of beef cattle manure, injected or incorporated manure within a week of application. However, regardless of farm size, beef farms had the highest percentage of manure left on the ground for more than a week.

Similarly, larger dairy and hog farms injected or incorporated manure into the soil to a greater extent than smaller farms. For example, 23.0% of the largest dairy farms (more than 131 dairy cows and heifers), corresponding to 33.5% of dairy cattle manure production, injected or incorporated manure on the same day of application. Similarly, 33.2% of hog farms, producing 45.7% of hog manure, injected or incorporated manure on the same day of application. The largest hog farms injected or incorporated manure without delay to the greatest extent, as one-third of these farms incorporated almost half of the manure they produced on the same day that manure was applied to their land. In comparison, 22.3% of

manure was injected or incorporated the same day it was applied on the smallest hog farms (less than 566 hogs).

For dairy farms, the largest (more than 131 dairy cows and heifers) had 33.5% of dairy cattle manure injected or incorporated into the soil the same day of its application. This compares to 25.7% on the smallest farms (less than 47 dairy head). Farms with larger dairy herds stored a higher proportion of liquid manure while smaller dairy farms stored a higher proportion of solid manure.

The highest proportion of manure that was left on the surface or incorporated more than a week after its application was mainly on beef farms, regardless of the herd size. Dairy and hog farms reported shorter delays in incorporating manure in the soil.

Table 6: Timing of manure incorporation into the soil, by size of herd, Canada, 2001

Herd size	Manure injected or incorporated the same day		Manure incorporated within 1 to 7 days		Manure incorporated after more than 7 days or left on surface	
	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)
Beef cattle						
1-162 head	13.3	10.8	31.3	31.7	55.4	57.5
163-281 head	13.8	13.9	32.5	33.5	53.7	52.6
282-425 head	15.0	13.4	31.9	37.0	53.0	49.6
426 or more head	16.6	17.5	34.9	36.3	48.5	46.2
All farm sizes	**13.4**	**13.1**	**31.5**	**33.6**	**55.1**	**53.3**
Dairy cows and heifers						
1-46 head	14.6	25.7	32.7	31.3	52.6	43.0
47-81 head	17.2	19.8	39.5	39.6	43.3	40.6
82-131 head	19.0	22.4	38.5	39.7	42.5	37.9
132 or more head	23.0	33.5	32.0	35.3	45.0	31.2
All farm sizes	**17.5**	**25.2**	**36.5**	**37.2**	**46.1**	**37.6**
Hogs						
1-565 head	16.5	22.3	35.6	38.8	48.0	38.9
566-981 head	21.1	19.9	29.6	37.1	49.3	43.0
982-1,594 head	25.3	29.8	36.5	39.0	38.2	31.2
1,595 or more head	33.2	45.7	32.5	31.2	34.3	23.0
All farm sizes	**21.9**	**38.5**	**34.3**	**33.8**	**43.9**	**27.7**

Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

2.3 Treatment of stored manure

Stored manure can be treated in various ways to limit odours, to minimize nutrient loss, or to reduce the moisture content (and therefore weight) of manure that will later be hauled to the fields. For example, composting solid manure is a type of aerobic treatment that kills pathogens, reduces volume and odours, and leaves stable humus that is easier to handle, either for spreading on land or for packing and selling to others. Aeration, mixing slurry with air, is used primarily to reduce the production of odours in stored manure. Liquid or semi-solid manure can be treated either by separating water from manure solids or bedding materials, by drying, or by storing manure in anaerobic digesters that convert organic matter into methane and carbon dioxide. All these processes reduce the water content of manure. Other methods include basic sewage treatment procedures such as filtering liquid manure through constructed wetlands or artificial marshes where nutrients are naturally removed or captured by vegetation.

It is important to note that farmers may have called conventional solid manure storage "composting". If this is the case, the data for "composting" will be an overestimate. The use of this term should be limited to the controlled regimen of monitoring and turning manure to allow complete aerobic decomposition of organic matter into humus.

Table 7 shows the regional differences in the adoption of manure treatment practices. Alberta, Saskatchewan and Manitoba farms treated stored manure to the greatest extent, 72.2%, 67.1% and 64.7% respectively. Quebec and Manitoba had the largest percentage of farmers using aeration, 6.8% and 6.7% respectively. The highest proportion of farms that dried manure was reported in each of the Prairie provinces, as well as New Brunswick and British Columbia.

Generally, manure additives are not used to a great extent. Nationally, only 1.8% of farms included them in their manure management. Of particular interest, though, is that New Brunswick reported the highest proportion of farms (4.6%) that used additives.

Table 7: Treatment of stored manure, Canada and provinces, 2001

	Aeration	Additives	Filtrating marsh	Composting	Drying	Other treatments	None
	Share of farms with livestock (%)						
Newfoundland and Labrador	0.0	0.0	X	X	X	0.0	77.8
Prince Edward Island	X	X	X	39.5	7.5	3.0	50.0
Nova Scotia	2.6	X	X	46.2	X	X	40.7
New Brunswick	X	4.6	X	X	16.0	X	51.7
Quebec	6.8	2.0	0.3	11.0	1.4	4.3	77.7
Ontario	2.9	3.1	0.8	28.6	9.1	4.5	58.0
Manitoba	6.7	X	X	51.1	19.4	6.1	35.3
Saskatchewan	2.1	X	X	44.0	31.2	7.2	32.9
Alberta	3.5	0.8	0.2	60.2	18.2	4.8	27.8
British Columbia	3.8	X	X	48.2	15.1	9.1	39.4
Canada	**4.0**	**1.8**	**0.4**	**37.8**	**14.6**	**5.3**	**47.9**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

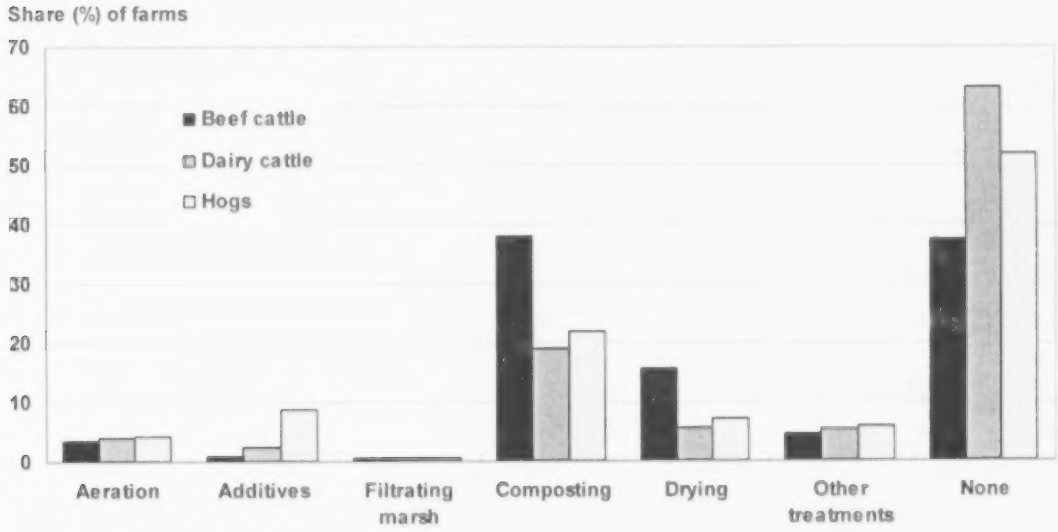
Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

2. Shares sum to more than 100% because an individual farm could report more than one type of treatment.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

FEMS results show that typically, dairy and hog farms in Canada treated manure to a lesser extent than beef farms in 2001 (Figure 5). Nearly two-thirds of dairy farms and over one-half of hog farms did not treat manure. Additives were used most extensively by hog farms, while composting and drying were more prevalent on beef farms in 2001.

Figure 5: Treatment of stored manure, by animal type, Canada, 2001



Source: Statistics Canada, 2001 Farm Environmental Management Survey.

2.4 *Feeding strategies to reduce manure nutrient content*

Feed additives or specialized feeding strategies have been designed to reduce the nutrient content of manure and to help animals make the best use of their feed. For example, the enzyme *phytase* improves the ability of pigs and poultry to digest the phosphorus in feed, hence reducing the risk of phosphorus pollution due to manure. Phosphorus run-off from farmland into water bodies can cause eutrophication through the overgrowth of algae and aquatic plants, which reduces oxygen levels in the water.

FEMS results show that nationwide, only 3.8% of farms in Canada used feed additives or specialized feeding strategies in 2001 (Table 8). This represents only 6.3% of the manure produced. Provincially, these results show significant variations. The use of feed additives or specialized feeding is above the national average in Quebec, Nova Scotia and Ontario, for both the proportion of farms and the proportion of manure produced. More specifically, Quebec had the highest proportion of farms that have adopted a specialized feeding strategy or feed additives (8.7%), representing the highest proportion of manure production (14.3%) modified by feeding practices of any province. This greater use of additives can be explained by the importance of hog production in Quebec and by the strict provincial regulations to prevent phosphorus pollution. Over time, phosphorus has been building up in much of the land in Quebec, as the amount of nutrients applied to fields has exceeded the amount that could have been used by crops.

Table 8: Use of feeding strategies to reduce manure nutrient content, Canada and provinces, 2001

	Farms using feeding strategies		Farms not using feeding strategies		Don't know	
	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)
Newfoundland and Labrador	X	X	X	F	0.0	0.0
Prince Edward Island	X	X	X	X	X	5.1
Nova Scotia	4.8	8.4	91.4	88.5	3.8	3.2
New Brunswick	X	3.0	91.6	95.9 [E]	X	1.2
Quebec	8.7	14.3	89.2	84.1	2.1	1.6
Ontario	4.6	7.4	91.5	88.4	3.9	4.1
Manitoba	2.5	2.6	92.4	91.3	5.2	6.1
Saskatchewan	1.9	5.6	95.1	90.1	3.0	4.3
Alberta	2.2	4.2	94.0	91.5	3.8	4.3
British Columbia	2.2	3.0	94.3	93.4	3.5	3.6
Canada	**3.8**	**6.3**	**92.7**	**89.8**	**3.5**	**4.0**

[E] Use with caution.
F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table 9 shows that feeding strategies to reduce manure nutrient content are most frequently used in the hog industry. Nationally, 18.8% of hog farms, producing 39.2% of hog manure, used feed additives or specialized feeding to reduce the nutrient content of manure in 2001. This compares to 4.2% of dairy farms and 2.5% of beef farms, representing 5.2% and 2.9% of dairy and beef cattle manure production, respectively. The largest hog farms (1,595 pigs or more) made the greatest use of these feeding strategies; 40.4% of these farms, accounting for 44.5% of hog manure, reported using feed additives or specialized feeding strategies. Even on farms with the smallest hog herds, the share of manure produced on farms using feed additives (13.4%) was greater than that produced on the largest beef farms (4.5%) or the largest dairy farms (8.3%).

Table 9. Use of feeding strategies to reduce manure nutrient content, by size of herd, Canada, 2001

	Farms using feeding strategies		Farms not using feeding strategies		Don't know	
	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)	Share of farms with livestock (%)	Share of manure produced on these farms (%)
Beef cattle						
1-162 head	2.3	1.9	94.6	95.1	3.1	3.0
163-281 head	3.9	3.7	91.3	91.3	4.8	5.0
282-425 head	2.3	2.7	95.1	95.4	2.6	1.9
426 or more head	5.9	4.5	87.2	89.7	6.9	5.7
All farm sizes	**2.5**	**2.9**	**94.2**	**93.2**	**3.3**	**3.9**
Dairy cows and heifers						
1-46 head	3.3	3.2	92.2	91.3	4.4	5.5
47-81 head	4.1	4.3	93.0	92.9	2.9	2.8
82-131 head	4.0	4.0	92.3	92.1	3.7	3.9
132 or more head	8.4	8.3	87.1	87.4	4.5	4.2
All farm sizes	**4.2**	**5.2**	**92.1**	**91.0**	**3.7**	**3.9**
Hogs						
1-565 head	7.3	13.4	88.5	79.4	4.2	7.2
566-981 head	X	X	64.5	64.4	X	X
982-1,594 head	X	X	68.2	61.0	X	X
1,595 or more head	40.4	44.5	53.8	49.8	5.8	5.7
All farm sizes	**18.8**	**39.2**	**77.1**	**55.9**	**4.1**	**4.9**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: **1.** Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

2. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

2.5 Control of odours from livestock buildings

Manure odours from livestock buildings, which pose site-specific concerns, can be reduced in different ways. To control odours, farmers can install windbreaks, filters on exhaust fans, and other devices.[7] To choose the appropriate odour control method, various factors need to be taken into consideration, including costs of practices, effectiveness of strategies and proximity of livestock facilities to neighbouring communities.

FEMS results show that 18.7% of livestock producing farms in Canada used some method to control livestock odours in 2001 (Table 10). The most popular method of odour control were wind barriers, reported by 10.9% of livestock farms. These relatively low figures reflect the fact that odour control is not necessarily an issue, especially if a livestock farm is relatively small or located far away from communities or neighbours. Furthermore, 9.0% of farms with livestock did not have barns or buildings for livestock; hence the issue is not relevant for these farms.

Provincially, results differed significantly. Manitoba had the highest percentage of farms using some method of odour control (36.9%) while Quebec had the lowest (13.0% of farms). Wind barriers were used to the greatest extent in the Prairie provinces. The use of wind barriers in the Prairie provinces may be encouraged through the availability of the Prairie Farm Rehabilitation Administration (PFRA) Shelterbelt Program. Manitoba had the highest proportion of farms using wind barriers to control odours (28.1% of farms). Finally, filter fans were used to the greatest extent in Nova Scotia, Prince Edward Island, and Ontario (respectively 9.9%, 9.3%, and 6.8%).

The majority of livestock producing farms do not use any method to control odours from their livestock buildings. In 2001, almost three-quarters (74.4%) of farms with livestock in Canada reported not having a method to control odours. The largest proportions of farms with livestock that did not report any method to control odours were in Quebec (86.5%) and New Brunswick (79%), though several provinces were not too far behind.

Table 11 shows that 33.2% of hog farms had some method of odour control. This compares to 18.3% for both beef farms and dairy farms. Wind barriers, the most commonly used method, were in place on 17.3% of hog farms.

Methods used to control odours from livestock building also varied by herd size. Larger farms with livestock generally reported more frequent adoption of odour control methods on their livestock buildings. This is especially true in the hog sector. In 2001, the farms with the largest hog herds (1,595 hogs or more) reported a larger share of wind barriers (27.0%) and other methods (14.5%) than smaller hog farms. This is not surprising, as large modern intensive hog operations maintain a high concentration of animals in a confined area and can generate significant odours if not managed properly. Furthermore, odour control methods were more likely to be found even on farms with the smallest hog herds (less than 566 hogs) than on farms with beef and dairy cattle of any herd size.

[7] While this section looks at ways of dealing with odours emanating from livestock facilities, aeration is also used primarily as an odour control method, by mitigating odours in stored manure. Refer to Section 2.3 Treatment of stored manure.

Table 10: Control of odours from livestock buildings, Canada and provinces, 2001

	Wind barriers	Filters on fans	Other	Total odour control methods [1]
	Share of farms with livestock (%)			
Newfoundland and Labrador	X	X	X	X
Prince Edward Island	7.3	9.3	X	X
Nova Scotia	X	9.9	10.6	X
New Brunswick	8.3	X	6.0	X
Quebec	7.4	2.2	3.3	13.0
Ontario	8.2	6.8	5.5	20.6
Manitoba	28.1	3.5	5.3	36.9
Saskatchewan	11.0	1.3	3.0	15.3
Alberta	10.9	2.4	3.2	16.5
British Columbia	6.0	2.7	7.0	15.7
Canada	**10.9**	**3.5**	**4.2**	**18.7**

	Total odour control methods [1]	No livestock buildings	No odour control methods
	Share of farms with livestock (%)		
Newfoundland and Labrador	X	0.0	82.1
Prince Edward Island	X	X	80.0
Nova Scotia	X	X	72.0
New Brunswick	X	X	79.0
Quebec	13.0	1.1	86.5
Ontario	20.6	1.3	79.7
Manitoba	36.9	10.3	56.7
Saskatchewan	15.3	12.7	75.1
Alberta	16.5	18.8	66.8
British Columbia	15.7	9.6	76.9
Canada	**18.7**	**9.0**	**74.4**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: [1] "Total odour control methods" is the simple sum of the shares of "Wind barriers", "Filters on fans" and "Other".

2. Because an individual farm could report more than one method the total will be greater than 100%.

3. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table 11: Control of odours from livestock buildings, by size of herd, Canada, 2001

	Wind barriers	Filters on fans	Other odour control methods	Total odour control methods [1]
	Share of farms with livestock (%)			
Beef cattle				
1-162 head	11.3	3.0	3.7	18.1
163-281 head	12.9	3.0	3.1	18.9
282-425 head	17.5	4.4	3.3	25.2
426 or more head	11.9	2.7	2.7	17.4
All farm sizes	**11.6**	**3.1**	**3.6**	**18.3**
Dairy cattle				
1-46 head	8.3	6.7	2.5	17.6
47-81 head	6.5	X	X	X
82-131 head	7.0	5.9	7.6	20.5
132 or more head	7.2	X	X	X
All farm sizes	**7.3**	**6.2**	**4.8**	**18.3**
Hog				
1-565 head	13.3	6.6	6.6	26.6
566-981 head	17.0	6.9	6.9	30.8
982-1,594 head	22.6	X	12.6	X
1,595 or more head	27.0	X	14.5	X
All farm sizes	**17.3**	**7.0**	**8.8**	**33.2**

	Total odour control methods [1]	No livestock buildings	No odour control methods
	Share of farms with livestock (%)		
Beef cattle			
1-162 head	18.1	9.6	74.2
163-281 head	18.9	16.4	67.9
282-425 head	25.2	20.3	58.1
426 or more head	17.4	19.9	66.7
All farm sizes	**18.3**	**10.5**	**73.2**
Dairy cattle			
1-46 head	17.6	2.6	81.9
47-81 head	X	X	84.2
82-131 head	20.5	1.1	80.5
132 or more head	X	X	80.7
All farm sizes	**18.3**	**1.2**	**82.4**
Hog			
1-565 head	26.6	6.3	70.8
566-981 head	30.8	0.0	72.5
982-1,594 head	X	X	65.7
1,595 or more head	X	X	57.3
All farm sizes	**33.2**	**3.9**	**68.0**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: [1] "Total odour control methods" is the simple sum of the shares of "Wind barriers", "Filters on fans" and "Other".

2. Because an individual farm could report more than one method the total will be greater than 100%.
3. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

2.6 Development of formal manure management plans

Specific manure management plans (MMPs) or broader nutrient management plans (NMPs) usually include records for each of the farm's fields and information on soil test results, nutrient requirements of crops, crop yields, rotation plans, and of course, nutrient application from manure and commercial fertilizers. The purpose of both MMPs and NMPs is to balance the application of nutrients with crop requirements, thus reducing nutrient losses to the environment.

According to the 2001 FEMS, 17.7% of all livestock producing farms in Canada had developed a formal MMP (Table 12). Overall, 7.8% of the farms (13.1% of manure production) developed their MMP as part of a broader NMP. Another 5.9% of the farms (8.4% of manure production) developed their MMP because it was required by government regulations. An additional 4.0% of the farms (4.8% of manure production) developed their MMP mainly because of farmers' personal concerns for the environment.

The development of MMPs differ significantly on a provincial basis, mostly due to differences in farmers' codes of practices, provincial regulations or municipal by-laws. For example, Quebec had the highest proportion of farms (52.3%) that had developed a MMP, accounting for 67.6% of manure produced in 2001. Also, 29.4% of farms in this province, representing 40.8% of manure production, had developed a MMP to comply with government regulations. In addition, 19.0% of Quebec farms (23.5% of manure) had developed a MMP as part of a broader NMP. This reflects the more stringent provincial regulations introduced in 1998 in Quebec to reduce pollution from agricultural sources.

The rest of Canada, however, had a significantly lower proportion of farms that had prepared a MMP. Regulations in these provinces tend to require such plans only for the very large and intensive livestock operations.

Nationally, the dairy sector had the highest proportion of farms (38.4%) that had developed a MMP, followed closely by the hog sector (35.4% of farms) (Table 13). In contrast, beef farms had the lowest proportion of farms (13.7%) with MMPs. Overall, 17.6% of dairy farms, 14.0% of hog farms and 6.6% of beef farms had developed a MMP as part of a broader NMP. In addition, 15.3% of dairy farms and 16.0% of hog farms had developed a MMP to comply with regulations, compared to 3.2% of beef farms. Moreover, about 5% of both dairy and hog farms developed a MMP because of farmers' concerns for the environment.

Table 12: Development of formal manure management plan, Canada and provinces, 2001

	Required by government regulations	Part of nutrient management plan	Concerns for environment	No formal plan
	Share of farms with livestock (%)			
Newfoundland and Labrador	X	X	X	79.3
Prince Edward Island	X	X	X	86.1
Nova Scotia	1.7	7.9	4.8	85.6
New Brunswick	4.0	4.0	3.2	88.9
Quebec	29.4	19.0	3.9	47.7
Ontario	2.5	8.4	7.4	81.7
Manitoba	2.8	4.3	3.4	89.5
Saskatchewan	0.5	4.3	2.2	93.0
Alberta	0.6	4.7	2.5	92.2
British Columbia	2.3	4.9	3.4	89.4
Canada	**5.9**	**7.8**	**4.0**	**82.3**
	Share of manure produced on these farms (%)			
Newfoundland and Labrador	X	X	X	F
Prince Edward Island	3.9	5.6	5.6	84.9
Nova Scotia	X	X	X	X
New Brunswick	6.2	5.1	3.4	85.3
Quebec	40.8	23.5	3.3	32.4
Ontario	4.4	14.0	9.7	72.0
Manitoba	8.1	5.6	4.8	81.6
Saskatchewan	2.2	9.1	3.7	85.0
Alberta	1.7	13.5	3.2	81.6
British Columbia	2.1	7.7	6.1	84.1
Canada	**8.4**	**13.1**	**4.8**	**73.7**

F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table 13: Development of formal manure management plan, by animal type, Canada, 2001

	Required by government regulations	Part of nutrient management plan	Concerns for environment	No formal plan
	Share of farms with livestock (%)			
Beef cattle	3.2	6.6	3.9	86.3
Dairy cattle	15.3	17.6	5.5	61.6
Hog	16.0	14.0	5.4	64.6
	Share of manure produced on these farms (%)			
Beef cattle	2.4	9.7	4.0	83.8
Dairy cattle	17.2	19.9	6.9	56.0
Hog	32.7	23.5	5.0	38.8

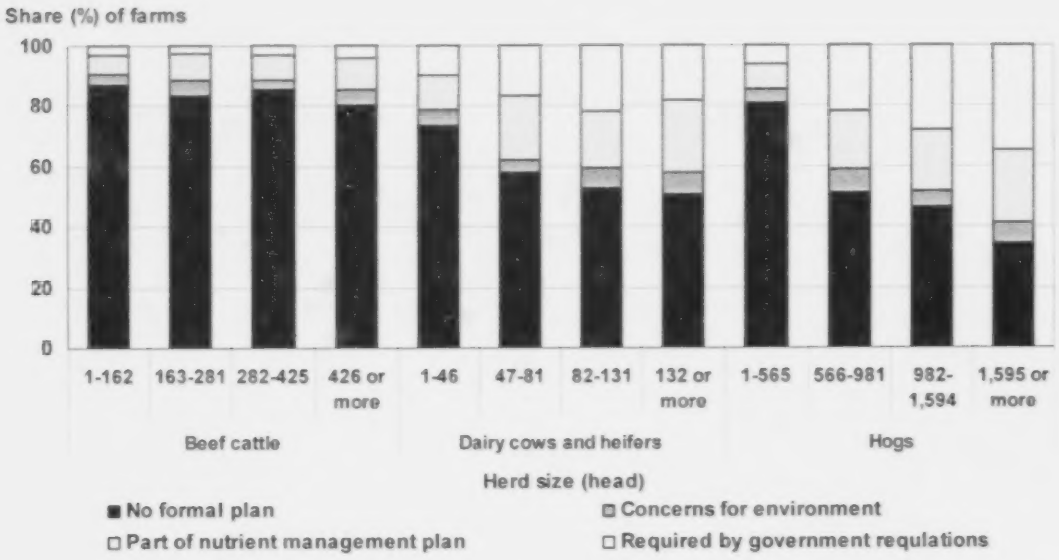
Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Figure 6 shows that MMPs were more prevalent on farms with larger herds in 2001. As an example, 49.4% of the largest dairy farms (more than 131 dairy cows and heifers) developed a MMP, compared to 26.6% of the smallest dairy farms (less than 47 dairy cows and heifers). Amongst the largest dairy farms, 24.0% had developed a MMP as part of a NMP, 18.3% to comply with regulations and 7.1% out of concerns for the environment.

MMPs were the most prevalent on large hog farms (more than 981 pigs) where more than one-half of farms had developed a MMP. Of particular note, more than two-thirds of the largest hog farms (more than 1,594) had developed a formal MMP. In addition, more than one-third of the these largest hog farms had developed a MMP to comply with regulations and about one-quarter of these farms had developed a MMP as part of a NMP.

The largest hog farms had the highest percentage (65.4%) of farms using a MMP. The smallest hog farms (less than 566 animals) had a smaller percentage (6.3%) of farms required to use a MMP; these farms also reported a small share (8.5%) of MMPs developed as part of a broader NMP. These low percentages reduce the overall share of hog farms that employ an MMP. Note that if the smallest hog farm size was removed, the average percentage of hog farms using a MMP climbs to 56.0%.

Figure 6: Development of formal manure management plan, by size of herd, Canada, 2001



Source: Statistics Canada, 2001 Farm Environmental Management Survey.

2.7 Adoption of beneficial management practices for manure management

Beneficial management practices (BMPs), often based on regional conditions, encompass farm production or management practices that reduce environmental risks or realize environmental benefits. Manure management BMPs are designed to prevent runoff, protect groundwater and surface water, and minimize manure nutrient losses and odour emissions into the environment.

Nationally, almost 40% of farm respondents (with 41.7% of manure produced) indicated that they were unfamiliar with local BMPs for manure management in 2001 (Table 14), suggesting a real need for education and awareness of beneficial practices. An additional 30.5% (with 7.7% of manure produced) reported that manure management BMPs were not relevant for their operation; these would likely be primarily crop farms with small livestock enterprises. Conversely, 17.8% of farm respondents whose operations represented 32.6% of manure production had fully implemented the BMPs related to manure management. In addition, 10.7% of farm respondents whose operations represented 15.9% of manure production had partially implemented BMPs for manure management.

There were important regional differences in the implementation of BMPs. These differences were mostly due to variations in provincial regulations, farmers' local codes of practices and farming practices, and types of agricultural production taking place. All of these factors are functions of regional agronomic conditions. Of particular interest, the provinces with the highest adoption of manure management BMPs were Quebec and British Columbia. In Quebec, 65.4% of farms representing 92.5% of manure production had fully or partially implemented manure management BMPs. Meanwhile, British

Columbia reported 33.7% of farms, producing 56.5% of manure, with fully or partially implemented manure management BMPs.

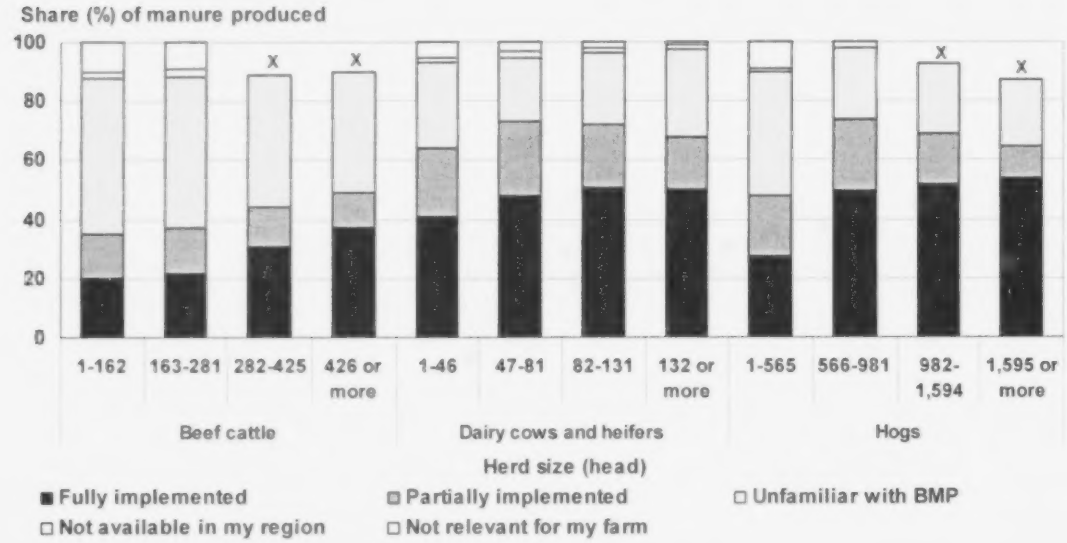
Figure 7 shows that the implementation of BMPs for manure management was also related to herd size. Almost two-thirds of the hog manure produced by the three categories of the larger hog farms (more than 565 hogs) was on farms that had fully or partially implemented BMPs for manure management. This contrasts with 48.1% for the hog manure on the smallest farms (less than 566 hogs). Similarly, 48.8% of beef cattle manure produced by the largest beef farms (more than 425 beef cattle) was on farms that had fully or partially implemented BMPs for manure management compared to 34.8% of beef cattle manure on the smallest farms (less than 163 head).

Table 14: Beneficial management practices for manure management, Canada and provinces, 2001

	Fully implemented	Partially implemented	Not available in my region	Not relevant for my farm	Unfamiliar with BMP
	Share of farms with livestock (%)				
Newfoundland and Labrador	36.8	X	0.0	X	26.3
Prince Edward Island	26.6	X	X	X	34.0
Nova Scotia	9.2	X	X	17.4	61.3
New Brunswick	14.4	10.9	2.4	32.6	39.7
Quebec	47.6	17.8	0.6	29.0	4.9
Ontario	14.2	15.0	1.3	32.2	37.3
Manitoba	20.7	10.2	1.8	30.8	36.5
Saskatchewan	6.6	4.2	3.4	30.5	55.3
Alberta	12.5	9.0	0.8	27.8	49.9
British Columbia	24.8	8.9	3.2	43.6	19.6
Canada	**17.8**	**10.7**	**1.7**	**30.5**	**39.2**
	Share of manure produced on these farms (%)				
Newfoundland and Labrador	F	X	0.0	X	16.8
Prince Edward Island	36.0	33.0	X	X	27.8
Nova Scotia	X	X	X	1.0	61.1
New Brunswick	24.8	24.7	9.7	7.5	33.2
Quebec	70.5	22.0	0.4	3.8	3.3
Ontario	27.3	25.1	1.5	3.9	42.2
Manitoba	37.7	17.1	2.0	4.3	38.9
Saskatchewan	16.8	8.4	6.4	8.7	59.6
Alberta	25.0	12.5	0.7	10.1	51.7
British Columbia	45.2	11.3	3.4	19.4	20.6
Canada	**32.6**	**15.9**	**2.1**	**7.7**	**41.7**

F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Figure 7: Beneficial management practices for manure management, by size of herd, Canada, 2001



X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Note: The X's represent suppression of both the "Not available in my region" and "Not relevant for my farm" categories.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

3 Summary

Canadian livestock farmers have a wide choice of options for managing the manure produced on their farms and farmers have to find the proper approach to deliver manure to their crops with minimal environmental impact. If manure is not utilized by plants and soil, excess nutrients may accumulate in the soil or seep into groundwater systems.

The 2001 FEMS provides key information about:

- seasonal application of manure to farmland;
- how and when manure is incorporated into the soil after it is spread on fields;
- the treatment of stored manure;
- feeding strategies farmers use to reduce nutrient content of manure;
- odour control options;
- adoption of manure management plans and nutrient management plans; and
- the implementation of beneficial management practices specific to manure management.

The survey shows that the adoption of manure management practices varies by province, type of animals produced and size of herd. These factors are interrelated as regional variations in climate and agronomic conditions lead to the different types of animals raised, which in turn impacts the type of manure being managed (solid/semi-solid or liquid), the production system used (animal raised under confinement or outdoors) and environmental regulations and issues.

Nationally, FEMS data show that:

- 37.3% of manure was applied to land in the fall, 34.7% in spring and 25.3% in summer. A smaller proportion (2.7%) of manure was applied during the winter;
- most of the beef cattle manure (43.6%) was applied in the fall. In contrast, most of dairy cattle and hog manure (over 40% for both) was applied during the spring;
- there was little difference in the seasonal application of manure to land between farms with smaller or larger herds;
- 47.1% of manure produced in 2001 was left on the surface of the soil or incorporated into the soil more than a week after its application. Meanwhile, 17.7% of manure was injected or incorporated into the soil the same day the manure was applied to the land;
- most beef cattle manure (53.3%) was left on the surface or incorporated into the soil more than a week after its application while 38.5% hog manure was injected or incorporated into the soil the same day it was spread on the field;
- farms with larger herds had the largest proportions of manure injected or incorporated into the soil without delay;
- 3.8% of Canadian livestock farms used feed additives or feeding strategies to reduce manure nutrient content; however, 40.4% of large hog farms (more than 1,594 pigs) operated under a regimen that used feed additives or rations formulated to reduce manure nutrient content;
- About one-quarter of Canadian livestock farms used some method to control manure odours from livestock buildings. The highest share of livestock buildings with odour control methods were found on hog farms;
- 8.4% of manure produced was on farms that had formal manure management plans required by government regulations, 13.1% of manure was on farms that had nutrient management plans and 4.8% of manure was on farms that had manure management plans developed because of concerns for the environment; manure management plans were more predominant on farms with larger herds;

- 32.6% of manure produced was on farms where respondents reported that they had fully implemented the beneficial management practices related to manure management in their region while 15.9% of manure was on farms having partially implemented these practices for manure management. Conversely, 41.7% of manure was on farms where the farm operators were unfamiliar with beneficial management practices for manure in their region.

Appendix A

Manure production coefficients

For some questions, information collected on the 2001 FEMS questionnaire is not sufficient on its own in providing a comprehensive explanation of results because very few of the FEMS questions requested information on the number of animals or the number of acres. Most of the FEMS questions were of a categorical type where respondents had to either check a Yes or No box or check boxes indicating specific practices. This type of question is useful for estimating the number and proportion of responses, but alone, does not give a full appreciation of the significance of the adoption of specific practices. For example, it is possible to estimate both the proportion of farms that reported composting manure and the number of farms that composted manure. But the responses provide valuable information only on the extent to which the farming community has adopted farming practices that are environmentally-sound. They do not provide much information on the significance of adoption in terms of potential pressures on the environment. For example, several smaller farms may have adopted a practice that is particularly helpful in protecting the environment, resulting in a high value for adoption. However, the overall contribution of these farms to the environment (i.e. total acreage or animals under this beneficial practice) may be marginal because the practices of a few very large farms more than offset the contribution of all these small farms.

To better assess the importance (to the environment) of manure management practices, results are frequently presented on the basis of the distribution of manure produced on farms using the different practices. It is possible to derive more meaningful estimates, such as the total amount of land on which manure was applied, using the FEMS link with the 2001 Census of Agriculture. The Census of Agriculture provides estimates of the number of animals on farms. Manure production coefficients can then be applied to these animal number estimates to provide an estimate of the total annual amount of manure produced on each farm. This, along with estimates of the number of farms, provides a more complete picture of the adoption of specific practices and the potential impact of these practices on the environment. Coefficients used to calculate manure production are presented in the following table.

Table A.1: Manure production (as excreted) coefficients by animal type, Canada, 2001

	Average live weight [1]	Daily manure production	Data source	Annual manure production	
	(lbs)	(lbs/day)		(lbs/year)	(kgs/year)
CATTLE					
Calves, under 1 year	450	26.1	A	9,530	4,320
Steers, 1 year and over	1,000	58.0	A	21,170	9,600
Beef replacement heifers	950	55.1	A	20,110	9,120
Dairy replacement heifers	950	81.7	A	29,820	13,530
Slaughter and feeder heifers	900	52.2	A	19,050	8,640
Beef cows	1,400	81.2	A	29,640	13,440
Dairy cows [2]	1,350	137.1	A,B	50,040	22,700
Bulls, 1 year and over	1,600	92.8	A	33,870	15,360
HOGS					
Boars	350	8.2	C	2,990	1,360
Sows and gilts for breeding [3]	275	8.2	C	2,990	1,360
Nursing and weaner pigs	25	3.7	C	1,350	610
Grower and finisher pigs [4]	135	7.8	C	2,850	1,290

[1] Average live weight of animals over this stage of their production cycle.
[2] Lactating and dry cow are assumed to have different manure production coefficients. At any given time, 17.5% of cows are assumed to be dry.
[3] The coefficient for gestating sows is used, as nursing piglets are included with nursing and weaner pigs.
[4] Growers and finishers spend 37.5%, 25.0% and 37.5% of their production cycle, respectively at each of the three size classes, defined by Oklahoma State University in their study.

Sources:
A: American Society of Agriculture Engineers, ASAE D384.1 FEB03.
B: Midwest Plan Service publication, no. MWPS-18 "Manure Characteristics," 2000 as quoted on the Michigan State University Extension website.
C: Oklahoma State University, "Production and Characteristics of Swine Manure," F-1735.

Appendix B: Statistical tables

Table B1: Seasonal application of manure, Canada and provinces, 2001

	Winter	Spring	Summer	Fall
	Number of farms with livestock			
Newfoundland and Labrador	0	115	30	80
Prince Edward Island	X	670	X	520
Nova Scotia	X	990	X	790
New Brunswick	40	705	455	705
Quebec	35	12,410	12,520	7,380
Ontario	3,845	16,655	10,590	15,525
Manitoba	970	2,745	3,110	5,670
Saskatchewan	945	4,330	4,970	9,810
Alberta	1,855	8,765	5,610	12,220
British Columbia	825	2,645	1,360	1,445
Canada	**8,630**	**50,030**	**39,660**	**54,145**
	Manure produced on these farms (thousand tonnes)			
Newfoundland and Labrador	0.0	92.6 [E]	21.4	56.2
Prince Edward Island	X	422.0	X	324.8
Nova Scotia	22.3	564.5	374.0	388.8
New Brunswick	11.6	472.2	296.3	392.4
Quebec	X	9,347.8	X	3,494.1
Ontario	1,117.2	10,073.9	5,822.7	7,828.5
Manitoba	302.6	2,334.5	2,612.9	6,397.6
Saskatchewan	347.5	5,611.8	5,017.5	9,443.9
Alberta	1,172.3	11,636.9	8,090.7	17,197.2
British Columbia	277.9	2,597.1	884.6	1,663.4
Canada	**3,269.2**	**43,153.4**	**32,565.3**	**47,187.0**

E Use with caution.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B2: Seasonal application of manure, by size of herd, Canada, 2001

Size of herd	Winter	Spring	Summer	Fall
	Number of farms with livestock			
Beef cattle				
1-162 head	4,445	27,740	22,620	34,160
163-281 head	540	2,260	1,635	3,075
282-425 head	100	770	570	955
426 or more head	270	945	750	935
All farm sizes	**5,355**	**31,715**	**25,575**	**39,125**
Dairy cows and heifers				
1-46 head	775	4,685	4,125	4,105
47-81 head	720	6,355	5,620	5,070
82-131 head	615	3,760	2,890	2,785
132 or more head	300	1,790	1,440	1,430
All farm sizes	**2,410**	**16,590**	**14,075**	**13,390**
Hogs				
1-565 head	1,080	3,670	2,460	3,660
566-981 head	275	1,130	735	865
982-1,594 head	245	1,340	830	1,015
1,595 or more head	260	1,695	1,005	1,360
All farm sizes	**1,860**	**7,835**	**5,030**	**6,900**
	Manure produced on these farms (thousand tonnes)			
Beef cattle				
1-162 head	796.8	10,774.5	9,875.8	18,020.4
163-281 head	563.7	4,222.7	3,062.4	6,770.8
282-425 head	77.9	2,504.1	1,837.3	2,993.7
426 or more head	585.8	6,180.7	4,216.2	6,786.0
All farm sizes	**2,024.3**	**23,681.9**	**18,991.7**	**34,570.9**
Dairy cows and heifers				
1-46 head	138.9	1,668.7	1,730.0	1,246.7
47-81 head	215.0	4,415.4	3,793.0	2,760.2
82-131 head	335.2	3,983.9	2,742.3	2,110.4
132 or more head	219.1	4,067.6	2,707.0	2,481.2
All farm sizes	**908.1**	**14,135.6**	**10,972.2**	**8,598.5**
Hogs				
1-565 head	50.9	375.2	249.5	325.6
566-981 head	42.3	467.9	248.1	259.6
982-1,594 head	68.9	998.0	477.5	583.1
1,595 or more head	172.6	3,206.4	1,433.6	2,617.8
All farm sizes	**334.7**	**5,047.4**	**2,408.6**	**3,786.2**

Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B3: Timing of manure incorporation into the soil, Canada and provinces, 2001

	Injected or incorporated the same day	1 - 7 days	More than 7 days or left on surface
	Number of farms with livestock		
Newfoundland and Labrador	X	X	165
Prince Edward Island	X	X	905
Nova Scotia	255	525	1,815
New Brunswick	280	605	1,020
Quebec	5,335	11,540	15,470
Ontario	7,915	17,935	20,775
Manitoba	2,270	3,940	6,300
Saskatchewan	1,875	5,035	13,130
Alberta	4,520	7,900	16,030
British Columbia	710	1,255	4,320
Canada	**23,380**	**49,160**	**79,930**
	Manure produced on these farms (thousand tonnes)		
Newfoundland and Labrador	X	F	F
Prince Edward Island	120.9	288.1	470.1
Nova Scotia	X	X	X
New Brunswick	182.8	476.8	513.0
Quebec	4,039.8	8,133.3	10,001.7
Ontario	4,896.0	10,644.7	9,301.6
Manitoba	2,424.3	3,897.7	5,325.6
Saskatchewan	2,835.6	6,088.8	11,496.2
Alberta	6,835.1	12,971.2	18,296.8
British Columbia	844.5	1,573.0	3,005.6
Canada	**22,369.5**	**44,382.6**	**59,422.6**

F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B4: Timing of manure incorporation into the soil, by size of herd, Canada, 2001

Size of herd	Injected or incorporated the same day	1 - 7 days	More than 7 days or left on surface
	Number of farms with livestock		
Beef cattle			
1-162 head	11,795	27,840	49,330
163-281 head	1,035	2,440	4,035
282-425 head	360	765	1,270
426 or more head	480	1,010	1,405
All farm sizes	**13,670**	**32,055**	**56,040**
Dairy cows and heifers			
1-46 head	2,000	4,485	7,210
47-81 head	3,055	7,005	7,690
82-131 head	1,910	3,870	4,265
132 or more head	1,140	1,585	2,227
All farm sizes	**8,105**	**16,945**	**21,392**
Hogs			
1-565 head	1,790	3,865	5,215
566-981 head	635	890	1,485
982-1,594 head	870	1,255	1,315
1,595 or more head	1,435	1,405	1,480
All farm sizes	**4,730**	**7,415**	**9,495**
	Manure produced on these farms (thousand tonnes)		
Beef cattle			
1-162 head	4,263.8	12,521.5	22,682.3
163-281 head	2,039.0	4,895.2	7,685.3
282-425 head	991.1	2,742.6	3,679.4
426 or more head	3,107.1	6,452.9	8,208.8
All farm sizes	**10,400.9**	**26,612.3**	**42,255.7**
Dairy cows and heifers			
1-46 head	1,400.6	1,700.6	2,339.9
47-81 head	2,249.9	4,488.4	4,599.2
82-131 head	2,124.3	3,761.3	3,586.0
132 or more head	3,428.6	3,609.5	3,187.6
All farm sizes	**9,203.3**	**13,559.8**	**13,712.7**
Hogs			
1-565 head	223.7	388.1	389.3
566-981 head	202.8	377.8	437.4
982-1,594 head	633.9	829.6	664.0
1,595 or more head	3,398.9	2,320.2	1,711.3
All farm sizes	**4,459.3**	**3,915.6**	**3,202.0**

Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B5: Treatment of stored manure, Canada and provinces, 2001

	Aeration	Additives	Filtrating marsh	Composting	Drying	Other treatments	None
	Number of farms with livestock						
Newfoundland and Labrador	0	0	X	X	X	0	105
Prince Edward Island	X	X	X	395	75	30	500
Nova Scotia	35	X	X	630	X	X	555
New Brunswick	X	55	X	X	190	X	615
Quebec	1,215	360	55	1,970	250	770	13,865
Ontario	740	795	195	7,330	2,345	1,160	14,860
Manitoba	605	X	X	4,595	1,740	545	3,175
Saskatchewan	345	X	X	7,060	5,000	1,160	5,275
Alberta	695	165	45	12,040	3,645	960	5,560
British Columbia	150	X	X	1,885	590	355	1,540
Canada	**3,840**	**1,700**	**400**	**36,280**	**14,030**	**5,070**	**46,050**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

2. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B6: Treatment of stored manure, by size of herd, Canada, 2001

Size of herd	Aeration	Additives	Filtrating marsh	Composting	Drying	Other treatments	None
	Number of farms with livestock						
Beef cattle							
1-162 head	2,285	550	235	25,115	10,035	3,130	25,840
163-281 head	245	70	55	2,335	1,090	175	1,540
282-425 head	X	X	X	705	345	115	535
426 or more head	X	X	X	625	315	75	640
All farm sizes	**2,605**	**640**	**315**	**28,780**	**11,785**	**3,495**	**28,555**
Dairy cows and heifers							
1-46 head	220	205	50	1,870	475	475	4,935
47-81 head	450	115	90	1,480	445	485	5,785
82-131 head	185	120	X	805	X	210	2,955
132 or more head	110	145	X	350	X	110	1,395
All farm sizes	**965**	**585**	**155**	**4,505**	**1,300**	**1,280**	**15,070**
Hogs							
1-565 head	260	285	X	2,170	730	X	2,940
566-981 head	30	195	X	165	25	X	975
982-1,594 head	75	180	X	85	X	115	1,065
1,595 or more head	125	360	X	185	X	140	1,190
All farm sizes	**490**	**1,020**	**55**	**2,605**	**855**	**700**	**6,170**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: **1.** Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

2. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B7: Use of feeding strategies to reduce manure nutrient content, Canada and provinces, 2001

	Farms using feeding strategies	Farms not using feeding strategies	Don't know
	Number of farms with livestock		
Newfoundland and Labrador	X	X	0
Prince Edward Island	X	X	X
Nova Scotia	70	1,330	55
New Brunswick	X	1,150	X
Quebec	1,640	16,775	390
Ontario	1,310	25,835	1,105
Manitoba	250	9,375	525
Saskatchewan	405	20,485	650
Alberta	675	28,825	1,165
British Columbia	130	5,525	205
Canada	**4,535**	**110,425**	**4,185**
	Manure produced on these farms (thousand tonnes)		
Newfoundland and Labrador	X	F	0.0
Prince Edward Island	X	X	49.5
Nova Scotia	116.3	1,230.0	44.0
New Brunswick	34.8	1,119.0 [E]	13.5
Quebec	3,077.6	18,159.0	355.5
Ontario	1,950.7	23,150.0	1,084.8
Manitoba	341.4	12,065.1	802.6
Saskatchewan	1,476.3	23,777.0	1,145.0
Alberta	2,252.5	48,491.3	2,276.8
British Columbia	236.1	7,372.0	288.1
Canada	**9,512.7**	**136,407.8**	**6,059.8**

[E] Use with caution.
F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: **1.** Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B8: Use of feeding strategies to reduce manure nutrient content, by size of herd, Canada, 2001

Size of herd	Farms using feeding strategies	Farms not using feeding strategies	Don't know
	Number of farms with livestock		
Beef cattle			
1-162 head	1,685	69,200	2,270
163-281 head	240	5,550	290
282-425 head	45	1,835	50
426 or more head	120	1,770	140
All farm sizes	**2,090**	**78,355**	**2,750**
Dairy cows and heifers			
1-46 head	270	7,475	360
47-81 head	345	7,890	245
82-131 head	175	4,065	165
132 or more head	175	1,825	95
All farm sizes	**965**	**21,255**	**865**
Hogs			
1-565 head	490	5,975	285
566-981 head	X	890	X
982-1,594 head	X	1,085	X
1,595 or more head	800	1,065	115
All farm sizes	**2,205**	**9,015**	**480**
	Manure produced on these farms (thousand tonnes)		
Beef cattle			
1-162 head	1,004.0	49,154.1	1,530.2
163-281 head	704.7	17,312.7	943.7
282-425 head	258.4	9,081.9	178.3
426 or more head	1,095.3	21,668.1	1,385.4
All farm sizes	**3,062.4**	**97,216.9**	**4,037.6**
Dairy cows and heifers			
1-46 head	153.5	4,436.9	268.9
47-81 head	479.9	10,323.2	314.0
82-131 head	367.6	8,545.3	361.2
132 or more head	794.2	8,324.3	401.5
All farm sizes	**1,795.2**	**31,629.7**	**1,345.6**
Hogs			
1-565 head	144.6	856.1	77.8
566-981 head	X	744.5	X
982-1,594 head	X	1,491.3	X
1,595 or more head	3,425.4	3,829.7	439.0
All farm sizes	**4,846.7**	**6,921.7**	**605.7**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: **1.** Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

2. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B9: Control of odours from livestock buildings, Canada and provinces, 2001

	Wind barriers	Filters on fans	Other	Total odour control methods [1]
	Number of farms with livestock			
Newfoundland and Labrador	X	X	X	X
Prince Edward Island	75	95	X	X
Nova Scotia	X	145	155	X
New Brunswick	105	X	75	X
Quebec	1,390	420	625	2,435
Ontario	2,330	1,925	1,555	5,810
Manitoba	2,845	355	535	3,735
Saskatchewan	2,365	270	640	3,275
Alberta	3,330	735	985	5,050
British Columbia	355	160	415	930
Canada	**12,970**	**4,190**	**5,040**	**22,200**

	Total odour control methods [1]	No livestock building	None
	Number of farms with livestock		
Newfoundland and Labrador	X	0	115
Prince Edward Island	X	X	820
Nova Scotia	X	X	1,055
New Brunswick	X	X	995
Quebec	2,435	215	16,235
Ontario	5,810	365	22,540
Manitoba	3,735	1,040	5,740
Saskatchewan	3,275	2,715	16,115
Alberta	5,050	5,755	20,455
British Columbia	930	570	4,545
Canada	**22,200**	**10,695**	**88,615**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: [1] Includes "wind barriers", "filters on fans" and "other".

2. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
3. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B10: Control of odours from livestock buildings, by size of herd, Canada, 2001

Size of herd	Wind barriers	Filters on fans	Other	Total odour control methods [1]
	Number of farms with livestock			
Beef cattle				
1-162 head	8,270	2,220	2,700	13,190
163-281 head	780	180	185	1,145
282-425 head	340	85	65	490
426 or more head	240	55	55	350
All farm sizes	**9,630**	**2,540**	**3,005**	**15,175**
Dairy cows and heifers				
1-46 head	675	545	205	1,425
47-81 head	550	X	X	X
82-131 head	310	260	335	905
132 or more head	150	X	X	X
All farm sizes	**1,685**	**1,440**	**1,110**	**4,235**
Hogs				
1-565 head	895	445	445	1,785
566-981 head	235	95	95	425
982-1,594 head	360	X	200	X
1,595 or more head	530	X	285	X
All farm sizes	**2,020**	**820**	**1,025**	**3,865**

	Total odour control methods [1]	No livestock building	None
	Number of farms with livestock		
Beef cattle			
1-162 head	13,190	6,975	54,175
163-281 head	1,145	990	4,110
282-425 head	490	395	1,130
426 or more head	350	400	1,345
All farm sizes	**15,175**	**8,760**	**60,760**
Dairy cows and heifers			
1-46 head	1,425	210	6,635
47-81 head	X	X	7,125
82-131 head	905	50	3,545
132 or more head	X	X	1,690
All farm sizes	**4,235**	**280**	**18,995**
Hogs			
1-565 head	1,785	425	4,760
566-981 head	425	0	1,000
982-1,594 head	X	X	1,045
1,595 or more head	X	X	1,125
All farm sizes	**3,865**	**450**	**7,930**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes: [1] Includes "wind barriers", "filters on fans" and "other".

2. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
3. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B11: Development of formal manure management plan, Canada and provinces, 2001

	Required by government regulations	Part of nutrient management plan	Concerns for environment	No formal plan
	Number of farms with livestock			
Newfoundland and Labrador	X	X	X	115
Prince Edward Island	X	X	X	870
Nova Scotia	25	115	70	1,245
New Brunswick	50	50	40	1,120
Quebec	5,515	3,575	730	8,970
Ontario	720	2,365	2,100	23,090
Manitoba	280	435	345	9,060
Saskatchewan	105	920	470	19,980
Alberta	195	1,435	755	28,285
British Columbia	135	290	200	5,265
Canada	**7,085**	**9,240**	**4,760**	**98,000**
	Manure produced on these farms (thousand tonnes)			
Newfoundland and Labrador	X	X	X	F
Prince Edward Island	37.1	53.0	53.6	809.4
Nova Scotia	X	X	X	X
New Brunswick	72.2	59.3	39.5	996.3
Quebec	8,810.9	5,061.2	720.8	6,985.9
Ontario	1,139.0	3,651.6	2,532.0	18,851.5
Manitoba	1,068.9	735.4	632.0	10,776.3
Saskatchewan	577.0	2,380.9	976.8	22,318.1
Alberta	876.6	7,144.9	1,717.5	43,273.3
British Columbia	164.4	603.3	480.6	6,612.3
Canada	**12,813.5**	**19,946.0**	**7,218.4**	**111,807.4**

F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B12: Development of formal manure management plan, by size of herd, Canada, 2001

Size of herd	Required by government regulations	Part of nutrient management plan	Concerns for environment	No formal plan
	Number of farms with livestock			
Beef cattle				
1-162 head	2,410	4,535	2,740	63,460
163-281 head	145	550	305	5,050
282-425 head	55	160	60	1,645
426 or more head	85	210	105	1,605
All farm sizes	**2,695**	**5,455**	**3,210**	**71,760**
Dairy cows and heifers				
1-46 head	785	935	430	5,945
47-81 head	1,405	1,785	380	4,875
82-131 head	965	830	315	2,320
132 or more head	385	505	150	1,065
All farm sizes	**3,540**	**4,055**	**1,275**	**14,205**
Hogs				
1-565 head	425	570	315	5,405
566-981 head	300	265	105	700
982-1,594 head	450	320	85	740
1,595 or more head	695	475	125	685
All farm sizes	**1,870**	**1,630**	**630**	**7,530**
	Manure produced on these farms (thousand tonnes)			
Beef cattle				
1-162 head	784.9	2,872.9	1,786.5	46,231.6
163-281 head	428.5	1,714.8	967.7	15,774.2
282-425 head	270.7	788.6	255.7	8,153.0
426 or more head	1,060.2	4,747.3	1,188.7	17,102.0
All farm sizes	**2,544.3**	**10,123.7**	**4,198.6**	**87,260.8**
Dairy cows and heifers				
1-46 head	588.8	651.9	237.9	3,378.4
47-81 head	1,910.0	2,369.2	517.4	6,303.0
82-131 head	2,047.7	1,667.8	717.2	4,889.7
132 or more head	1,443.5	2,247.1	917.8	4,886.7
All farm sizes	**5,990.1**	**6,936.0**	**2,390.3**	**19,457.8**
Hogs				
1-565 head	140.5	155.7	62.1	715.4
566-981 head	260.3	220.3	91.6	580.3
982-1,594 head	642.8	434.5	123.5	999.2
1,595 or more head	2,924.1	2,037.4	330.7	2,401.9
All farm sizes	**3,967.8**	**2,847.8**	**608.0**	**4,696.7**

Notes: *1.* Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B13: Beneficial management practices for manure management, Canada and provinces, 2001

	Fully implemented	Partially implemented	Not available in my region	Not relevant for my farm	Unfamiliar with BMP
	Number of farms with livestock				
Newfoundland and Labrador	105	X	0	X	75
Prince Edward Island	340	X	X	X	435
Nova Scotia	205	X	X	390	1,370
New Brunswick	265	200	45	600	730
Quebec	12,435	4,660	155	7,585	1,290
Ontario	6,175	6,485	570	13,975	16,170
Manitoba	3,180	1,575	270	4,740	5,620
Saskatchewan	2,885	1,855	1,500	13,375	24,305
Alberta	5,280	3,815	330	11,735	21,085
British Columbia	2,235	800	285	3,930	1,765
Canada	**33,105**	**19,895**	**3,205**	**56,645**	**72,845**
	Manure produced on these farms (thousand tonnes)				
Newfoundland and Labrador	F	X	0.0	X	30.1
Prince Edward Island	316.9	290.3	X	X	245.0
Nova Scotia	X	X	X	13.7	850.6
New Brunswick	292.7	292.0	115.1	88.3	392.4
Quebec	15,204.6	4,744.7	92.2	817.9	701.0
Ontario	7,163.0	6,573.2	391.4	1,011.9	11,071.6
Manitoba	4,929.0	2,233.1	257.6	564.2	5,093.0
Saskatchewan	4,426.6	2,211.9	1,697.1	2,301.1	15,721.0
Alberta	13,371.6	6,694.3	353.9	5,368.4	27,607.3
British Columbia	3,518.2	879.7	267.5	1,510.0	1,606.1
Canada	**49,584.8**	**24,164.6**	**3,245.7**	**11,699.5**	**63,318.2**

F Too unreliable to publish.
X Suppressed to meet confidentiality requirements of the *Statistics Act*.
Notes: 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.
2. Due to rounding, figures may not add up to totals.
Source: Statistics Canada, 2001 Farm Environmental Management Survey.

Table B14: Beneficial management practices for manure management, by size of herd, Canada, 2001

Size of herd	Fully implemented	Partially implemented	Not available in my region	Not relevant for my farm	Unfamiliar with BMP
	Number of farms with livestock				
Beef cattle					
1-162 head	16,410	11,750	1,455	9,395	36,405
163-281 head	1,240	935	160	530	3,005
282-425 head	590	265	X	X	875
426 or more head	615	320	X	X	840
All farm sizes	**18,855**	**13,270**	**1,710**	**10,325**	**41,125**
Dairy cows and heifers					
1-46 head	3,030	1,770	115	615	2,720
47-81 head	4,040	2,195	180	265	1,815
82-131 head	2,280	955	70	90	1,060
132 or more head	1,005	385	30	25	650
All farm sizes	**10,355**	**5,305**	**395**	**995**	**6,245**
Hogs					
1-565 head	1,430	1,030	115	900	3,560
566-981 head	685	315	0		360
982-1,594 head	840	280	X	X	350
1,595 or more head	1,120	270	X	X	490
All farm sizes	**4,075**	**1,895**	**140**	**1,095**	**4,760**
	Manure produced on these farms (thousand tonnes)				
Beef cattle					
1-162 head	10,314.7	7,870.6	1,105.2	5,243.9	27,747.7
163-281 head	3,965.4	2,808.1	465.5	1,685.8	9,397.6
282-425 head	2,949.8	1,244.7	X	X	4,276.7
426 or more head	8,972.3	2,770.5	X	X	9,855.9
All farm sizes	**26,202.2**	**14,693.9**	**2,095.5**	**9,942.0**	**51,277.9**
Dairy cows and heifers					
1-46 head	1,985.5	1,135.4	69.7	265.4	1,409.9
47-81 head	5,355.3	2,803.7	240.5	344.7	2,391.6
82-131 head	4,758.0	2,008.5	134.1	202.0	2,270.8
132 or more head	4,766.7	1,684.0	134.7	114.7	2,803.6
All farm sizes	**16,865.4**	**7,631.5**	**579.0**	**926.8**	**8,875.9**
Hogs					
1-565 head	307.8	230.2	12.5	102.8	465.6
566-981 head	578.9	280.2	0.0	22.3	285.4
982-1,594 head	1,150.7	377.1	X	X	524.9
1,595 or more head	4,084.1	826.5	X	X	1,719.9
All farm sizes	**6,121.5**	**1,714.0**	**747.4**	**549.0**	**2,995.8**

X Suppressed to meet confidentiality requirements of the *Statistics Act*.

Notes 1. Where no error letter appears by a number the standard error ranges between 0.005% and 12.49%. Results are considered excellent to acceptable.

2. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001 Farm Environmental Management Survey.